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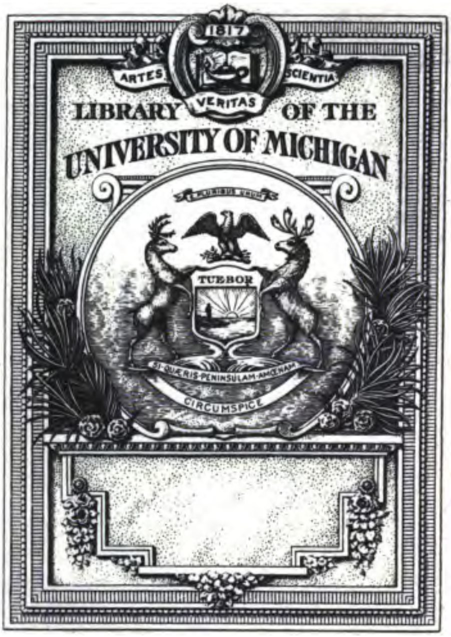

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APPARATUS FOR FISHING

International Fisheries Exhibition
LONDON, 1883

APPARATUS FOR FISHING

BY

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APPARATUS FOR FISHING.

In the following pages it is proposed to give only a general account of the various kinds of apparatus which are employed for fishing, but an endeavour will be made to describe in an intelligible manner the principal methods of fishing, so as to enable the reader to understand something of the means by which our fish-markets are supplied, and constant occupation given to the large class of fisherfolk—many of whom too commonly have to spend their lives in the midst of dangers and hardships but little understood by the great mass of the public who look on a regular supply of fish as a matter of course, whatever the weather may chance to be.

An important distinction exists between sea fishing and freshwater fishing, which gives to each an interest peculiar to itself. Sea fishing is a great commercial industry. Freshwater fishing is mainly connected with sport and amusement. The first will therefore naturally claim the principal share of our attention, as being the means of providing a very large supply of wholesome food, and consequently of wide-spread interest. Some of the appliances for fishing being used in both salt and fresh waters, it will be convenient to consider our subject with reference rather to the different methods of fishing than to any distinction between the waters in which they are carried on, calling attention, however, as occasion may arise, to the use of particular appliances in the capture of freshwater fishes as well as of those found exclusively in the sea. We shall therefore roughly divide the apparatus into Nets, Lines, and Traps, and begin our descriptions with the important group of nets, which may be again separated into those which are movable, or fixed, when in use.

NETS.

a. Movable—Trawls, Drift, Seines, etc.
b. Fixed—Trammels, Set-nets, Bag-nets, etc.

Trawls.—Among the several methods of fishing in general use in our seas none is of more importance than that known in England as trawling, as by its means we obtain the greater part of the turbot, brill, and soles which are brought to market, and soles are very rarely caught in any other way. But besides the value of this mode of fishing in the capture of what are known as "prime" fish, its importance is even greater as a means of catching plaice, haddock, whiting, and other kinds of common fish, which, inferior as they are usually considered when compared with turbot and soles, yet are in great and constant demand in the market, and from the abundance in which they are caught, they can be sold at so low a rate as practically to be within reach of everyone. Another point of importance in trawling is that it is carried on throughout the year, although as a good deal of wind is desirable for its effective working, it is more generally productive in winter than at any other season, and therefore at a time when some kinds of sea fishing are difficult on account of bad weather.

There are two kinds of trawl-net in use, the beam-trawl and the otter-trawl; but the only one used by professional fishermen is the beam-trawl, and of that we will now endeavour to give a description; but an examination of the net itself will be almost necessary to enable its construction to be clearly understood.

THE BEAM-TRAWL.

The Beam-trawl is a triangular, flat, purse-shaped net, with its wide mouth kept extended by a horizontal wooden spar called the "beam," which is raised a short distance from the ground by two iron supports or "heads," one at each end; the upper edge of the mouth of the net being fastened to the beam, and the under portion or lower edge of the opening dragging on the ground as the net is towed over the bottom. The size of the net used depends very much on that of the vessel that has to tow it, and the length of the beam of course varies with the size of the net. The total length of the net is usually rather more than twice that of the beam. In the large trawl vessels or "smacks," as they are generally called, the beam ranges from 36 to 50 feet in length, and the net in corresponding proportions. As there is an enormous strain on the beam when the net is at work, great care is necessary to select a good piece of wood for it. Elm is generally preferred, chosen if possible from timber grown of the proper thickness, that the natural strength of the wood may not be lessened by any more trimming or chipping than is absolutely necessary. If the required length and thickness cannot be obtained in one piece, two pieces are scarfed together and the joint secured by iron bands. Appearance here is not of so much consequence as strength and toughness to resist the strain to which the beam is exposed. It will be understood from what has been said that the purse-shaped net has one of its flat sides on the ground, and the mouth is kept extended by the beam lying across it; but in order to give room for the fish to enter, the beam and with it the back or upper edge of the mouth of the net fastened to it must be raised a certain distance from the ground. For this purpose each end of the beam is fastened to the top of an iron frame, shaped something like an irregularly formed stirrup, which is fitted to it at a right angle by a square socket at the top. By these iron frames, called "heads or irons," the beam is raised about three feet from the ground, and, contrary to the popular idea, never touches the bottom. It could do so only if the net and beam were to reach the ground with the back undermost, and then the mouth of the net would close and no fish could enter. The lower part of the trawl-head or iron is straight and flat, just like the corresponding part of a stirrup. It is called the "shoe," and is the part which slides over the ground as the net and beam are towed along. There is some slight variation in the shape of the irons used on different parts of the coast. What is called the Barking pattern is quite symmetrical and stirrup-like in shape, and is used by the Barking and many of the Great Yarmouth trawlers; but at Brixham, Grimsby, Hull, and most other of our stations the back of the trawl-iron is made straight and sloping backward to the heel of the "shoe," thus giving greater length to that part of the iron which rests on the ground, and consequently, it is thought, more steadiness. Other devices, both foreign and British, for keeping the beam off the ground, will be observed among the trawl-heads in this Exhibition.

The purse-shaped net consists of several portions, each having its own name. An old-fashioned bed watch-pocket laid on its face will give a very good idea of a trawl, when in a position for working. What is then its upper surface is called the "back," and the under portion the "belly" of the net. The straight front edge of the back, or "square" of the net is fastened to the beam, and is therefore raised two or three feet from the ground. The corresponding lower part of the mouth, however, is cut away in such a manner that the margin of the net forms a deep curve extending from the foot of one trawl-iron to the other, and therefore resting on the ground; the centre of the curve or "bosom" being a considerable distance behind the beam and in front of the narrow part of the net. The usual rule in English trawls is for the distance between the beam and the centre of the curve to be about the same as the length of the beam. In foreign trawls this distance is generally less; but in all cases there is a considerable space of ground over which the beam and back of the net must pass, when the trawl is at work, before the fish lying under them on the bottom are disturbed by the lower edge of the net.

This curved lower margin of the mouth of the net is fastened to and protected by the "ground-rope," which is made of a stout but old hawser "rounded" or covered with small rope to keep it from chafing and to make it heavier. Its purpose is to protect the edge of the net, which otherwise would soon be torn by contact with the ground, and especially to keep it evenly on the bottom so as to sweep it thoroughly and disturb the fish, which, passing over the rope, then find their way into the farther narrow end of the purse or bag. The ends of the ground-rope are fastened on each side by a few turns round the back of the trawl-iron, just above the shoe, so that the rope rests upon the ground throughout its entire curve. There is no chance therefore of the fish escaping at either the sides or bosom of the net, and their only outlet, when once the beam has passed over them, is in front, for the back of the net is then above them, so that they must dart forward in the direction in which the net is moving, to enable them to get clear of it. Their chance of escape is, however, very small, for when fish are disturbed without being much alarmed, they seldom move very far, and even should they escape under the beam, the net moving forwards in the same direction would most probably again overtake them. It has been mentioned that the ground-rope is made of an old hawser, and there is a reason for such being used. Although trawling is carried on as a rule over smooth ground, it sometimes happens that there may be an occasional piece of rock in the way, and then if the ground-rope were sound and strong the probable result would be the breaking of the beam or the more serious accident of the parting of the rope by which the trawl is connected with the vessel. In the latter case the whole trawl would be lost; but if the ground-rope were to become hitched in a rock or any obstruction at the bottom, an old rope would break, and the most serious result would be the tearing of the under part of the net. This, of course, is to be avoided if possible, but it is better to tear the net than lose it altogether.

We have so far spoken only of the front half of the trawl, with its back entirely made up of netting and the under part of the same material cut away into a deep curve which is fastened to the ground-rope. The remaining part of the trawl, that is, the portion extending from the bosom to the extreme end, forms a complete bag of netting, and gradually diminishes in breadth until within about ten feet of the end. This last part of it is of uniform width, and is called the "cod" or "purse;" it is here that the fish which enter the net are mostly collected, and they are prevented from escaping by the end of this bag or purse being closed by a draw-rope when the net is in use. As soon, however, as the net is hoisted in, the draw-rope is cast off, and the fish fall out on the deck of the vessel. The under part of this purse is exposed to a good deal of wear from the weight of fish and sometimes stones collected within it, and to protect it as much as possible, layers of netting, called "rubbing-pieces," are laced across it, one layer slightly overlapping the next one. In French trawls a stout hide is frequently fastened under this part of the net for the same purpose. Such is the main construction of the trawl as seen from the outside; but we have still to notice certain arrangements within the net by which any fish which have once made their way into the cod or purse at the end are prevented from returning and making their escape.

The net has been described as tapering away from the mouth until the purse is reached, and it is at the junction of the purse with the main body of the net that by a very simple arrangement two pockets open, into which the fish make their way and often become closely packed. The pockets are made by simply lacing together parts of the upper and under portions of the main body of the net, beginning close to the purse, at about one third of the distance across, and running up towards the outer margin, gradually tapering away to a point for a length of about sixteen feet backwards from the purse. They are therefore within the outer edge of the net, and their mouths open into and face the purse. The mouths of the pockets occupy one-third each of the breadth of the net at that part, and the intermediate third is the passage by which all the fish enter the purse from the main body of the net. Over this opening hangs a curtain of netting called the "flapper," which gives way before any fish pushing through into the purse, but then falls back so as to prevent its return. On each side of, and just beyond, the flapper, however, is the entrance to a pocket; and the fish, being unable to return through the passage closed by the flapper, very commonly enter the pockets and press on till at last the gradual narrowing of the space stops their further progress in that direction. To understand clearly the facilities offered to the fish to enter the pockets it is necessary to remember that the trawl when at work is towed along with just sufficient force to expand the net by the resistance of the water. But this resistance acts directly only on the interior of the body of the net between the pockets, and then on the purse. When the trawl first begins to move, the pressure of the water inside the net does not distend the pockets, but rather tends to flatten them, because they are virtually outside the cavity of the net, and their openings are at the farther end of it and facing the other way. The water, however, which has expanded the body of the net, then makes its way under the flapper and enters the purse, which, being made with a much smaller mesh than the rest of the net, offers so much resistance that it cannot so readily escape in that direction; return currents are consequently formed along the sides, and these currents open the mouths of the pockets, which face the purse or last part of the net; and the fish in their endeavours to escape, finding these openings, follow the course of the pockets until they have no room to proceed any further. The whole of the net becomes therefore fully expanded, but it does so by the pressure of the water in one direction through the middle, and in the opposite one through the pockets at the sides.

Such then is the beam-trawl—an enormous bag-net, frequently 50 feet wide at the mouth and upwards of 100 feet in length, which sweeps slowly and quietly over the bottom of the sea, disturbing, perhaps without much alarming, such fish as may come in contact with the ground-rope, and, we may venture to say, ultimately securing them in the purse and pockets, from which there is no deliverance till the trawl is hoisted up on board the vessel and the contents are turned out on deck.

In an ordinary deep-sea trawl-net the meshes are of four sizes, diminishing from four inches square near the mouth to an inch and a half at the purse or small end; and the twine for the under side of the net is usually a size larger than that for the back. The net is generally made of the best Manilla hemp, and is well tarred before being used. The only remaining part of the trawl apparatus is the warp by which the trawl is towed over the ground. This is usually a six-inch rope, 150 fathoms long, and made up of two lengths of 75 fathoms each, spliced together. The end of this warp is shackled to two other pieces, each 15 fathoms long, and called the "spans" or "bridles," which lead one to each end of the beam, and are shackled to swivel-bolts in the front of the head-irons, so that the pull of the rope comes directly on those parts of the apparatus which are the most exposed to friction by contact with the ground.

As most of the trawling is carried on far out at sea, and very commonly at long distances from land, good sea-going vessels are required, and vessels of from 45 to 70 tons, or even more, are generally employed in this kind of fishery. They are usually called "smacks" from their smack or cutter rig, which until recent years was the one almost invariably adopted. Forty or fifty years ago they were of comparatively small size, ranging from twenty to thirty-six tons. They were stoutly-built vessels, able to hold their own in almost any kind of weather, but were then not remarkable for fast sailing. Sea-going qualities were especially necessary in vessels which had to work in rough weather, and often at some distance from any harbour. The improvements in modern ship-building have not been, however, lost sight of, and the great and increasing demand for fish, and the long distances from land at which trawlers now work in the North Sea, have led to the construction of larger vessels, capable of working much heavier nets, and with much finer proportions, so as to give greatly increased speed so that the fish may be brought to market with as little delay as possible. The large mainsail in these smacks has great driving power, and is therefore a very important sail; but the increase in the size of the vessels has made a change of rig desirable so as to be able to work them without proportionately adding to the expenses. The larger mainsail in these new vessels would require additional hands to look after it in bad weather, when a heavy boom is likely to strain everything to the utmost; and fishing is a pursuit in which expenses must be closely looked after. This sail has accordingly been reduced in size, and a mizen mast has been added on which a small gaff-sail is carried. By this plan a proper quantity of sail can be carried, but the great pressure on it is brought lower down, and consequently it is more manageable and causes less strain on the vessel. The new trawlers are built of greater proportionate length than formerly, and this gives them greater speed. This new "ketch" rig, as it is called, is generally adopted at the great North Sea stations, Hull, Grimsby and Yarmouth, and is gradually coming into fashion at Brixham and other Channel ports. One important advantage in the increased size of these fishing vessels is the additional room provided on board. This not only adds to the comfort of the crew, but enables a considerable quantity of ice to be carried, now a necessary condition of North Sea trawling. Stowage is also provided for the produce of several days' fishing, when, as is the rule, except during the calm summer months, these trawlers stay out for several days at a time, and bring home their own fish instead of sending it in by carrying vessels, which at certain seasons collect the fish from a fleet of trawlers and take it to market.

The cost of trawl-smacks has greatly increased of late years, not only on account of their larger size, but because of the higher price that has now to be paid for everything connected with their construction. In 1862, a trawler, ready for sea, and what was then considered one of the larger class, could be built and fitted out for £700 or £800; but one of the new class of vessels cannot be turned out at the present time for less than about £1600. This includes a fit-out of all that is required for fishing, which costs from £70 to £80. A fit-out consists of a double set of almost every part of the gear, to provide against accidents, and to save the time which would otherwise be lost if the vessel were obliged to return to port before she had done a fair quantity of work. If a trawl-net meets with no serious accident it will last from three to four months, according to the nature of the ground worked on; but during that time parts of it will have to be renewed. The back of the net, being exposed to least wear, lasts the longest; the under parts will generally require renewing twice, and the cod or purse five or six times, before the whole net is finally condemned; so that trawling gear involves considerable expense to keep it in good working order at the best of times, and in case of accidents, by which sometimes the whole net and beam are lost, the cost is greatly increased.

The importance of the trawl fishery is so great that we have thought it desirable to give tolerably full details of the apparatus employed in it, and it may be interesting if we also give some account of the manner in which the net is worked. Of course, nothing but practical experience on board a trawler will enable one to thoroughly understand all the points to be considered in working under the varying conditions of wind and tide, but the general mode of proceeding may be more easily explained. A favourable tide is the first thing to be desired, one of only moderate strength, as the trawl, which is always towed as much as possible in the direction of, but a little faster than, the stream, then works steadily and is easily kept upon the ground. Supposing the vessel to be on her fishing ground, the first part of the tide is chosen for commencing work, as she can then tow in one direction for several hours, and the usual practice is to keep the trawl down till the tide has done, about five or six hours at a time. The vessel is put under easy sail in the direction in which she is going to tow, depending on the wind being suitable for going with the tide. This is of such importance that when the wind is dead against the tide it is impossible to work, and the fishermen can only beat up against the wind so as to take up a suitable position for trawling in the opposite direction as soon as the tide has turned, or if the fishing ground be a large one, as in some parts of the North Sea, they heave-to and wait for the favourable time. Most persons who have seen a trawl-vessel in harbour, or coming in or going to sea, will have noticed the long trawl-beam, with the curiously-shaped head-irons at each end, resting on the top of the bulwark, usually on the port or left side of the vessel, and the immense net lying in irregular folds along the top of the beam. This is where the trawl is stowed when it is not in use, and is conveniently placed for putting overboard when the net is to be lowered. This then would be the position when they are going to begin fishing. The vessel then being slowly sailed along her intended course, the first thing to be done is to get the net overboard, beginning with the small end and throwing it out or "shooting" it until the whole is hanging from the beam and towing alongside. The rope holding up the front end of the beam is then slacked away till that part of the beam is well clear of the vessel, and, being caught by the water, is turned outwards at nearly a right angle, or square with the stern. The other end is then lowered from the stern till the whole beam is level in the water with the net streaming away behind it; and if the trawl is then in a proper position, that is, with the back uppermost and the ground-rope below, more sail is put on the vessel, the two ropes fastened to the head-irons at the ends of the beam are slowly and evenly paid out till the shackle joining them to the trawl-warp is reached; then if all appears to be going right the warp itself is steadily given out, and the trawl is allowed to slowly sink to the bottom.

It will hardly be necessary to point out why the vessel should be moving through the water, although not very fast, when the trawl is being lowered. It will be obvious that if the apparatus is to reach the bottom with the trawl-irons under the beam, and the lower part of the net and the ground-rope in their proper position below, no risk must be run of the net turning round or twisting as it is being lowered. There would, of course, be great danger of this happening if the vessel were not moving; the net would in such a case hang perpendicularly, and the beam would be very liable to twist round, so that it would be a mere matter of chance whether the upper or under side of the net and beam would be the first to reach the bottom. If, however, as has been described, the net be got into a proper position when at the surface, and the vessel be slowly sailed along, the net is then towed after it, and as the warp is given out, the net gradually sinks without changing its position, until at last it reaches the ground. Of course, experience teaches the fishermen how to regulate the speed of the vessel and the rate at which the warp should be given out so as to ensure just sufficient strain on the trawl to keep it steady whilst it is sinking. These are matters which none but the practical fisherman thoroughly understands; they require some little judgment to prevent mistakes, and mistakes will sometimes be made; the strength of the tide may be miscalculated, or something else; and the irregular action of the trawl, owing to the beam instead of only the irons touching the ground, tells the fishermen that the trawl is "on its back." When this happens there is nothing to be done but to heave up the net—often a long and laborious process—and then, after getting it into the proper position, to lower it once more.

Supposing the trawl to have reached the bottom all right and to be moving evenly over the ground, as can be readily felt by the steady strain on the warp, the master uses his judgment as to how much more warp should be paid out. It should be remembered that the weight of the net and the trawl-irons, without considering the beam itself—which, from being so continually under water, soon becomes more or less saturated, and loses more of its original buoyancy—is such as to keep the whole apparatus at the bottom, whilst the pull of the warp by which the trawl is towed along, is in a direction slanting upwards. There are therefore two opposing forces, one tending to keep the net on the ground, and the other lifting it. The object is to regulate these forces so that the pull from the warp shall move the trawl lightly along the bottom, but without raising it from the ground. If then there be too little warp allowed and there be not slope enough, the pull will be too much upward, and the net will be lifted; but if, on the other hand, there be too much warp, the trawl-irons and net will be dragged too much on the ground, and the friction will be greatly increased. One of the conditions on which this regulation depends is the amount of wind; for if there be very little breeze to drive the vessel along, the friction of the net and irons on the bottom may be sufficient to stop her way entirely. In such a case, very little extra warp is required, so that the lifting power may be increased, and the friction over the ground lessened. But if there be a great deal of wind, which will drive the vessel along even with comparatively little sail, and especially if, as in such a case is likely to occur, there is a good deal of sea, and the strain on the warp becomes irregular and jerking, then more warp is allowed to counteract the tendency there is to lift the net off the ground. This, as has been said before, is a matter of experience; and the ready way in which these rough fishermen make their calculations, often, we may venture to say, without being able to explain their reasons, is shown by the successful manner in which they commonly fish in all kinds of weather. There is no other kind of sea-fishing which requires so much skill as deep-sea trawling; as, independently of the necessary knowledge of the ground to be trawled over, hours may be wasted unless attention is given to the proper management of the net from the moment at which it is put overboard.

We have spoken of the construction of the beam-trawl, and the way in which it is managed when it is being used; we may now say a few words about the action of the trawl when it is at work. This net is specially constructed for catching what are called ground-fish, those which, as a rule, keep at the bottom, and naturally hide more or less under the sand or mud. With trifling exceptions, all the turbot, brill, soles, and plaice brought to market, are caught by the trawl; the various kinds of skate or ray are obtained for the most part by the same means; and notwithstanding the peculiar habit all these fish have of lying quite close to the ground and partially covered, they have very little chance of escaping when once the trawl-beam has passed over them. Rough stones or rocks on the bottom would soon tear the net to pieces; and even on smooth ground there is danger of meeting with obstructions big enough to hold the net, sometimes resulting in breaking either the beam or the trawl-warp. Clean ground is therefore of the first importance for trawling; it is there that flat-fish are most likely to be found, and the action of the trawl is specially such as to secure them. The trawl, as has been said, is always towed with the tide, but a little faster than it is running. Were it otherwise, the net, being lighter than the beam, weighted as it is with the trawl-irons, would be liable to be drifted forwards and to prevent the entrance of the fish. The resistance of the water caused by the trawl going a little faster than the tide—this excess of speed varying according to circumstances from half a knot to a knot and a half in an hour—keeps the net expanded and in a proper position behind the beam. The ground-rope then does its duty. Its "biting" action, or close pressure on the ground over which it is towed, is of the greatest importance when soles, turbot, and other flat-fish are worked for, as these fish when disturbed do not rise from the ground as is the habit with whiting, haddock, gurnards, etc., but seek safety in the sand. When, therefore, as the trawl is slowly towed along, the ground-rope disturbs the flat-fish, their first impulse is to move a short distance forwards and again bury themselves; but the ground-rope is steadily pressing on as the trawl advances, and they are again soon disturbed. This proceeding almost certainly ends in the fish, sooner or later, passing over the ground-rope and entering the net. They cannot then escape upwards, because the back of the net is above them, and if they dart forwards towards the entrance they may have to go perhaps forty or fifty feet, the distance between the centre of the curved ground-rope and the beam, before they can get clear of the advancing net. When fishing for whiting, haddock, or other round fish, the trawl is towed a little faster than when working for soles, and although such fish on being disturbed may dart some little distance, the fact of their not trying to bury themselves, but to rise from the ground, often enables the ground-rope to pass under them without further disturbance.

The great resistance offered by the trawl to the forward movement of the vessel towing it—a resistance sufficient to reduce her speed in a good breeze from perhaps seven or eight knots to one knot in the hour—is very commonly ascribed to the supposed great pressure of the beam and net on the bottom, and to their not being towed lightly over the ground, but dragged through it. This has been the foundation of most of the arguments used by those who believe that trawling tears up the ground and destroys any fish spawn there may be upon it, they apparently being unaware that the trawl can only do its work when the beam is raised well clear of the ground by the trawl-irons, and that the weight of the net is very materially lessened by the fact of its being expanded by the water.

The question of spawn being destroyed by the trawl is further disposed of by the knowledge that has been gained in recent years of the spawning habits of sea-fish. It has been now distinctly proved by Professor G. O. Sars and M. Malm on the coasts of Norway and Sweden that the eggs of several of our best known sea-fish float during the whole period of their development, and that the herring is the only one among our market sea fishes whose spawn is positively known to be deposited on the bottom. As the usual spawning ground of the herring is in rough places, where the trawl cannot be worked, there is little probability of that net doing much mischief to herring spawn.

We now come to the last part of the operation of trawling—the taking up the net. After the trawl has been towed over the ground for five or six hours, the tide having come to an end, or the limit of the particular fishing ground having been reached, the net is then hauled up. There is not the same custom on all parts of the coast as to the position in which the vessel is placed when the trawl is hoisted up. At Brixham and Plymouth, the old trawling stations in the Channel, it has long been the practice to haul in the trawl-warp over the bow by means of a winch placed just in front of the mast, and the vessel is therefore brought head to wind with the trawl out ahead of her; and even when one of the improved patent capstans, placed in the middle of the vessel, is used, the warp is still led in over the bow; but among the trawlers in the North Sea the capstan is always employed, and the rope is hauled in over the port side of the vessel, just opposite the capstan. These, however, are very much a matter of fancy, and in either case there is long and often very laborious work to be done before the trawl comes to the surface. It rarely takes less than three-quarters of an hour's steady work, and in bad weather it may take two or three hours. The long warp is coiled away down below as it comes in, and the beam, having been swung alongside, hoisted up and secured, the net is gathered in by hand until nothing remains in the water except the cod or purse of the net, in which all the fish are collected, those which had entered the pockets having been shaken down into the purse as the main body of the net was hauled in. Now comes the exciting moment, and all hands have a look over the side of the vessel to see what has been the result of the day's work. If there are only a few fish in the purse it is lifted in by hand and better luck hoped for next time. But when, as often happens, there is from half to three-quarters of a ton of fish, the bag is hoisted up by a tackle, and before being lowered on board, the draw-rope, which has been previously mentioned as closing the end of the purse, is cast loose, and the whole quivering mass of fish falls out on the deck. The scene is a remarkable one, for most of the fish are alive and display such beauty of colouring as can only be observed when they are just taken out of the sea. The variety of fish is also frequently very great, and twenty different kinds—good, bad and indifferent—may be turned out after one haul of the net. At certain seasons, and in particular parts of the North Sea, the catch consists almosts entirely of haddocks, at other times plaice may be the principal fish, or the vessel may have been working on ground specially frequented by soles; but in any case there is sure to be a market for what has been caught, and if soles or turbot fetch a higher price than the commoner kinds, the latter are always more abundant. Sorting the fish is at once proceeded with. The prime fish are picked out and packed separately, and if the vessel is far away from the land, as in the North Sea, pounded ice is plentifully strewed among the fish, and every care is taken to preserve them in good condition till the opportunity comes for sending them to market. The vast numbers of haddocks which are taken by the trawl are not always packed in boxes like the prime fish, but, after being roughly cleaned, are stowed away with layers of ice between them in the hold of the vessel till in the course of a few days she returns to port. Although a great number of haddocks are sold fresh, the majority of those caught by the trawl are dried and smoked, for which there is an unfailing demand.

During the last few years one of the most important changes which have taken place in connection with deep-sea fishing has been the application of steam-power to trawl vessels. Many experiments have been tried from time to time with this object, but although there has been no doubt of the advantage of using steam for fishing boats, there has been great difficulty in keeping the attendant expenses within due limits. The system is indeed still in only partial operation, but enough has been done to show that its more general adoption is only a question of time. For many years steam vessels have been employed as "carriers," collecting the fish from the fleets of trawlers in the North Sea, and taking it to market. But experience has shown that time and labour can be profitably saved by applying steam to the actual fishing vessels. It enables them to go to and return from their fishing grounds quickly, and to work their nets independently of wind—a matter of the first importance in the light summer weather which sometimes for days together keeps the sailing trawler almost idle, and a large amount of time and labour is saved by the use of steam in hauling up the trawl. The numerous designs and models of steam-trawlers in the Exhibition point to the attention now being given to this important subject.

The fishing grounds systematically worked over by the trawlers are scattered over a large area, and lie principally on the southern half of the North Sea, a locality to which we have frequently had occasion to refer. The oldest known trawling grounds are, however, on the Devonshire coast, where the Brixham men have regularly worked for probably not much less than a hundred years. Brixham claims to be the "mother of trawling," although a similar claim has been put in by Barking, on the Thames. So far as we can ascertain, small trawls may have been used inshore for many years before these nets were tried in deep water, but it seems probable that Brixham took the lead in trawling at sea ; and there is no doubt that Brixham men introduced trawling at Ramsgate, and in 1845, many of them migrated to Hull, and thence systematically worked the important North Sea fishery now carried on from that port. In 1858 five trawlers left Hull for Grimsby, nearer the mouth of the Humber. It was the year before the opening of the Manchester, Sheffield, and Lincolnshire Railway at Grimsby; and since that date the Grimsby trawl-fishery has gone on increasing until it has become the most important in the United Kingdom, and the railway from the port daily conveys very large supplies of fish to the centre of the manufacturing districts. Yarmouth is another great trawling port on the North Sea, and received her first trawlers from Barking through the enterprise of the late Mr. Hewett, who, beginning his career as a boy on board one of these fishing smacks, lived to see a large fleet of vessels the property of himself and some members of his family. If deep-sea trawling were by any chance to come to an end, or even materially diminished, the result would be the loss of many thousands of tons of wholesome food to all classes of people in this country.

THE OTTER-TRAWL.

This net, although used in the same manner as the beam-trawl, differs from it essentially in having no beam, and the mouth of the net is kept open by means of long wings of netting, at the end of each of which is what is called an otter-board. On the action of these otter-boards depends in a great measure the proper working of the net. But before describing them we will say a few words about the construction and shape of the net. As the size of the net may vary according to that of the vessel from which it is to be worked, and as its use is practically confined to yachtsmen who have them made of suitable dimensions for their vessels, we need only give the general proportions of the two essential parts—the body and the wings. The body of an otter-trawl—say, 28 feet long—consists of a bag 28 feet in length, 10 feet square at the mouth, and the small end or purse about four feet square. This is closed with a draw-rope as in the same part of the beam-trawl. The wings for a trawl of the size we are describing are each about 36 feet long, and are fastened one on each side of the square mouth of the net, their height when joined to the trawl being 10 feet, the same as the trawl itself at that part. From this point the height of the wing gradually diminishes through its entire length of 36 feet, till it becomes reduced to two feet at the other end. The foot of the wings and of the mouth is weighted to keep it on the ground, and the upper edge or back of the same parts is buoyed up with pieces of cork. A nice adjustment of weights to corks is important to enable the net to work lightly over the ground, although at the same time closely touching it. We now have the funnel-shaped bag with a long wing of netting extending from each side of the mouth, and the remaining parts to be noticed are the all-important otter-boards by which the wings of the net are kept extended. Most persons are familiar with the principle of flying paper kites, but a few words may be here said on the subject. When the kite is thrown up in the air, the wind would of course blow it away if it were not for the string which keeps a strain upon it in an opposite direction ; and if this strain or pull upon it by the string were exactly at the centre of pressure of the wind on the surface of the paper, the kite would either remain steady or sway about in any direction. But if the string be fastened rather more on one side of the centre of pressure of the wind on the kite than on the other, then that part of the kite would be turned a little towards the wind and the rest of it in a corresponding degree away from it. The wind would therefore strike the kite at an angle and with the greatest effect on the part behind the string, tending to blow it away were it not that the pressure of the wind also, although in a less degree, on that part in front of the string, kept it from turning away too much. The kite is thus brought into the same position with respect to the wind as the sail of a vessel is when she is going what is called close to the wind. In both cases the wind strikes at an angle and flies off at the further edge, resulting in the sail and the kite being forced in the opposite direction. The kite, being weighted with the tail, turns its head upwards, and that being the part on which there is the least pressure of the wind, the kite rises in the air. Now if we substitute an otter-board for the kite and water for the wind, we shall find precisely the same principle in action.

The otter-board for such a net as has been described is an oblong piece of stout board two feet high and nearly three feet and a half long; the front lower angle is rounded off so as not to catch in the ground, and the whole lower edge of the board is weighted with a heavy iron shoe, as it is that part which is to be kept at the bottom. The end of each wing of the trawl is fastened to the square end of an otter-board, the round end of the board going in front, and all that is now wanted is to make fast a rope to the inner side of the board, in just such a position as a string is fastened to a kite. These ropes from the otters exactly correspond with the two ropes or bridles, one from each end of the beam in the beam-trawl, and like them the ends are shackled on to the warp by which the trawl is towed. Putting out or "shooting" the otter-trawl is generally done over the stern of the vessel, and the two ropes are brought round one on each side of it, so as to separate the wings of the net as much as possible from the first; and when the vessel begins to move slowly along, the pressure of the water acts on the otter-boards as the wind does on the kite. The direction of the otters, however, is not upwards but outwards, as they are weighted on the lower side and are too heavy to float; and as the strain on them continues they gradually work their way out in opposite directions until the two wings and the mouth of the net are expanded in a wide curve, the weighted foot of the whole extent of net being on the ground, and the corked back-rope keeping the upper edge of the net fully extended above it. The net is then towed with the tide, and is worked in just the same manner as has been described in the case of the beam-trawl. The two ropes or bridles leading from the otters, are much longer than would be used with a beam-trawl, as the front of the net with the wings spreads out to a great width. There being no beam to this trawl, it is very convenient for use in yachts, as it can be stowed away in a comparatively small space when not wanted, but professional trawlers cannot be induced to work with anything but the beam-trawl. Each has its advantages, but it may be a question whether our deep-sea trawlers would do better, or as well, with the otter-trawl as with the one to which they have been always accustomed. A net of just the same shape and construction is, we believe, still in use on some parts of the Irish coast, but it has no otter-boards, and the wings of the net are kept apart by the ropes from them leading each through a block at the end of a pole which is put out on each side of the trawling vessel. The end of each wing is kept upright by being fastened to a contrivance very much like a long double-headed hammer, the head being a long stout piece of flattened iron like the shoe of an otter-board, and with a stiff piece of wood like the handle of a hammer inserted into the middle of the iron, thus completing what we have called a long double-headed hammer. The top of the end of the wing of netting is fastened to the top of the handle, and the lower edge of the wing to one end of the iron shoe or hammer-head. The tow-rope or bridle from each wing is fastened to a loop extending from the front of the hammer to the top of the handle, so that when the trawl is at work, the hammers slide along over the ground with the handle standing upright in the middle. This trawl is known as the "Pole or Hammer" trawl, and the application of otter-boards to a trawl of this construction must be considered a decided improvement. A simple, but cumbrous and primitive mode of working the deep-sea trawl is that adopted on the Atlantic and Mediterranean coasts of Spain, where, instead of using the beam to keep the mouth of the net open, the trawl is towed between two vessels, which, from their always working together, are known as "Parejas" or pairs.

Two problems in connection with trawling have been the subject of much consideration at various times, but as yet have not been satisfactorily solved. One is to ensure the trawl reaching the bottom at all times in the right position for working; and the other is to provide for the escape of small fish without running the risk of losing the larger ones. The difficulty in the latter case arises from the fact that the strain on the last part or purse of the trawl when towed over the ground is so great that the meshes, no matter what size they are, are pulled straight and therefore closed; and if the meshes were made much larger than they are now, fair sized soles would have strength enough to open them sufficiently to squeeze through where the young fish would be unable to do so. Some suggested improvements on the latter point deserve attention among the variety of trawling gear exhibited.

DRIFT-NET FISHING.

This method of fishing, although not the oldest recorded, has yet been in use for a very long time, and there is good reason to believe that the long-famous Yarmouth herring fishery, of which we hear in the sixth century, has always been carried on by means of drift-nets. The importance of drift-net fishing is shown by the fact that it is the only method by which such fish as herrings, mackerel, and pilchards, which generally swim at or not very far from the surface, can be readily caught in the open sea, at any distance from land, and in any depth of water sufficient for the nets to float in their natural position.

The term "drift-nets" is derived from the manner in which the nets are worked. They are neither fixed, towed, nor hauled within any precise limit of water, but are "shot"—the fisherman's expression for throwing out or putting a net into the water—at any distance from the land where there are signs of fish, and are allowed to drift in any direction the tide may happen to take them, until it is thought desirable to haul them in. When at work, they are extended in a long single line, with their upper edge supported at or near the surface by means of floats, the nets hanging perpendicularly in the water, and forming, as it were, a perforated wall or barrier many hundred yards long and several yards deep. The shoals of fish, in their endeavours to pass through this barrier of netting, force their heads into the meshes, the size of the mesh used, of course, depending on whether herrings, pilchards, or mackerel are expected to be caught, and being such as to allow the head and gill-covers to enter, but not to permit the thicker body of the fish to pass through. When the fish has found its way through the net beyond the gill-covers, it may generally be looked upon as effectually meshed. There is then indeed very little chance of its escape, for the mesh is only large enough for a fish of an average size of its kind to push its way so far when the gill-covers are pressed close to the neck; but it is necessary for them to open again that the fish may breathe, that is, that the water which enters the mouth may, with the air it contains, pass over the gills, and after purifying the blood within them, just as the air we take into our lungs purifies the blood they contain, escape through the gill opening on each side of the head. This process must be familiar to anyone who has watched a living fish in an aquarium. While this is taking place, and the fish is at the same time struggling to pass through the net, the mesh slips forward and catches in the gill opening, from which it cannot easily be cleared without more or less injury to the fish. In drift-fishing then the floating nets act as barriers to intercept the moving shoals, and the fish become meshed in their attempts to pass through.

Long experience has shown that certain conditions are favourable to drift-fishing. It will of course be easily understood that the more indistinct the net is in the water, the more likely the fish are to swim against it and to become meshed. The night is, therefore, with very rare exceptions, the time chosen for drift-fishing; and it is noticed that just after sunset and just before sunrise, when the change is taking place from light to darkness, or the reverse, herrings especially are most likely to "strike" the net, as it is called. This is one point among many in connection with the habits of the herring which cannot at present be explained. A ripple on the surface of the water is also a favourable condition for fishing, and this will be readily understood; for if the surface of the sea be at all broken, such light as falls upon it, be it ever so little, is reflected or turned off by every little wave, and therefore does not penetrate to the nets so as to make them visible. During the last few years some very interesting observations have been made on the coast of Scotland on the temperature of the sea whilst the herring-fishing has been going on, and its possible relation to a successful fishery. The late Marquess of Tweeddale, who was President of the Meteorological Society of Scotland, provided a number of deep-sea thermometers to be used by the fishery officers and the fishermen for the purpose of testing the temperature of the sea at different periods of the fishery. The Committee who had charge of the experiments state that the conclusions arrived at so far must be considered as only provisional; but they point to a high degree of temperature in the sea being unfavourable to fishing, and that when the sea is found to be colder in any one district than in that on either side of it, the herrings are more abundant, and the fishery is more successful in the colder than in the warmer water. They also state that the influence of thunderstorms has been perceptible in several years. If there is a thunderstorm of some magnitude extending over a large portion of the east of Scotland, good takes of fish may be made on that day, but on the following one few if any fish are caught over that part of the coast, unless at the extreme verge of a deep part of the sea, as if the fish were retreating thither. Observations on the influence of winds and the temperature of the sea have also been made by the Dutch fishermen; and Herr von Freedon of Hamburg, Director of the German See-Warte, believes from an analysis of these observations that 57 degrees Fahrenheit is most favourable for the herring fishing, and that the chances of success diminish with higher and lower temperatures. These investigations are of great interest; and although it is yet early to predict what they may lead to, there are so many problems to be solved in connection with the movements of wandering fishes like the herring, pilchard, mackerel and sprat, that any bit of distinct knowledge we may gain about their habits may help materially to guide us in subsequent inquiries.

The nets used in drift-fishing or "driving," as the fishermen call it, are made either of cotton or hemp, the latter being generally known as "twine;" some fishermen preferring the one material, some the other; and it is not unusual for the two kinds to be placed alternately in the same train of nets. Not many years ago flax nets were used on some parts of the Irish coast. Cotton nets are now in general use; they are finer in the line and more flexible than those made of hemp, and they are generally believed to be more effective in meshing the fish. Very beautiful and ingenious machinery is employed in making these nets, as may be seen in the Exhibition, and large supplies for some years past have been turned out from the factories at Bridport, Musselburgh, and other towns. When new, cotton nets are first saturated with linseed oil, then squeezed through a machine, afterwards dried, which takes some days, and finally they are put into a vat, and hot bark liquor poured upon them; in this they remain for two or three days. The bark liquor is a preparation in which catechu, an Indian gum possessing great tanning properties, is an important ingredient, it having practically superseded the oak bark formerly used for tanning nets. In some cases, however, the nets are dressed with coal tar instead of being barked. The herring-nets come from the factory in "pieces" 60 yards long and 9 or 10 yards deep, the depth of the net containing 200 meshes; and it is the custom of the fishermen when speaking of the size of a net, to say that it is so many yards long and so many meshes deep. Each "piece" is divided into two nets 30 yards long. When a net is prepared for use, it is "mounted" or fastened along one edge of its length to a small line only 18 or 20 yards long, that length of line being appropriated to the 30 yards of net, so that the "lint," or netting, is set slack and gives way a little when the fish strike it; and from its flexibility the net meshes the fish better than would be the case if it were fully stretched. The ends of the net are called the "heads," the roped edge of the length the "back," as that is uppermost when the net is in the water, and the lower edge the "foot" or "sole." The heads are roped as well as the back, but the foot is left free, so as to be less likely to hitch in anything at the bottom when the nets chance to be used in rather shoal water or near the ground. The back of the net is further fastened at intervals of a few inches by very short lines termed "nossels" or "norsals," to the cork-rope, a small double-rope enclosing at various distances pieces of cork to keep that part of the net uppermost, but without sufficient buoyancy to float it at the surface. The number of nets used by each vessel depends very much on her size, and in the case of the Yarmouth luggers ranges from eighty to a hundred and thirty, or even more. These are fastened together end to end, and, thus united, form what is called, "a train, fleet, or drift of nets," frequently extending to a distance of more than a mile and a quarter. The mesh of a new herring net is about an inch and a quarter square, equivalent to from 30 to 32 meshes to the yard; but after long use and frequent barking or tarring, it becomes contracted to an inch, or even less, which is too small to catch the full-sized fish. Twine nets have been hitherto netted by hand, and for convenience in manufacture are usually made up of several narrow pieces called "deepings," which are laced together one below the other, there being three or four deepings in the depth of one of these nets. Twine nets are much heavier than those made of cotton, and consequently involve more labour in working them. There is very little doubt also that the comparative stiffness of the meshes prevents the fish being easily caught in them. On the other hand it has been said that the sharpness of the fine cotton mesh cuts into the neck of the fish, and tears off the head when the net is being hauled on board. The now general use of cotton nets shows, however, that the objection to them cannot be very serious.

We have mentioned that these drift-nets all have corks along the upper edge in order to keep that part of the net uppermost, at the same time with not sufficient buoyant power to float them. The reason for this last is that the herrings do not always keep at the surface or at the same distance below it. The nets have therefore to be sunk to various depths at different times, and it requires considerable experience in the fishery to enable the fishermen to judge of the most suitable depth on any particular night. The various conditions which guide the fishermen on this point would take up too much space to fully consider, but the result of their judgment in the matter is of the first importance, as it is a question of success or failure in the night's fishing. It is consequently the frequent practice of the fishermen to haul in the first of the nets, after they have been in the water for a time, to see in which part of the depth of the net most fish have been meshed, and to raise or lower the nets in the water as may seem most desirable. The nets are kept at the desired distance from the surface by means of buoys or small kegs, which for some reason are called "bowls," one of these being fastened by a long or short rope, as the case may be, to each net in the train, so that the nets can be allowed to sink to any reasonable distance that may be desired; and in order to secure the nets from loss, in case they should be cut through by some passing vessel or steamer, a long warp or stout rope is used to which each net is made fast by what is called a "seizing" —a small rope long enough to allow the warp to hang down considerably below the upper edge of the nets, and to take almost all the direct strain off the nets when they come to be hauled in. The fishing boats used in drift-fishing vary in size from those employed in the Yarmouth fishery—decked vessels of 36 tons—to the small open cobles on the Northumberland coast, and the number and size of the nets differ accordingly; but they are all worked on the same system, and if we say a few words on the method adopted at Yarmouth it will no doubt be sufficient to enable the general mode of working to be understood. The time universally chosen for "shooting" or putting out the nets is just before sunset; and the vessel having arrived in what the master has reason to think a likely place for fish—a point about which there is generally some degree of speculation, she is put before the wind, and as she sails slowly along, the net is shot over the quarter, that is, over the side near the stern. Whilst this is going on the men are distributed at regular stations, some handing up the net from the net-room, others throwing it overboard and taking care that it falls in the right position, others, again, looking after the warp and seeing that the seizings, or ropes from the net, are made fast to it at their proper distances. Everything has to be done in the most methodical manner, or the net may become twisted, or something else may go wrong so as to spoil the night's fishing. When, however, all the net is in the water, and fifteen or twenty fathoms of extra warp, termed the "swing-rope" are paid out, the warp is carried from the stern to the bow of the vessel; she is then brought round head to wind, the ordinary sails are taken in, the principal mast is lowered backwards until it can rest on a wooden crutch, and a small sail called the "drift-mizen" is set on the mizen mast so as to keep the vessel head to wind. The regulation lights—one over the other, to show she is fishing—are then hoisted, and part of the crew being told off as a watch upon deck, the vessel and nets are allowed to drift with the tide.

As it is important that a strain should be kept on the nets so as to extend them, it will be understood why the nets are shot in the direction in which the wind is blowing; for the vessel being to leeward of the line of nets, and of course offering more resistance to the wind than they do, drifts more rapidly, and consequently pulls upon the warp and the nets fastened to it, and keeps them comparatively straight. This being the case a large number of fishing boats are enabled to work at short distances from one another, their nets being in nearly parallel lines. There is no advantage, however, in the vessel drifting with the wind so fast as to drag the train of nets through the water; on the contrary, so long as the line of nets is kept tolerably straight, that is all that is wanted; and when there is a good deal of wind so as to blow the vessel away, more swing-rope is allowed, the "spring" of the warp easing the strain on the nets.

After the nets have been in the water a few hours, they are hauled in again, and this operation is performed in the same systematic manner as was mentioned in connection with shooting the nets. The men all have their regular stations, and a certain number of them work at the capstan by which the warp and with it the nets are hauled on board. As soon as the fish are all shaken out of the nets they are sprinkled with salt, and then stowed away in proper compartments of the hold of the vessel. The night's fishing being over, the mast is got upright again, the sails are set, and the vessel either returns to port with her fish, or moves to another likely place for the next night's fishing.

Drift-nets for mackerel are made and worked on precisely the same principle; but as these fish generally keep near the top of the water, the nets are well corked so as to make them float quite at the surface. They are not so deep as herring nets, but the train is very much longer, extending to as much as two miles and a half in length. The meshes are of course larger than those of a herring net, there being usually twenty-two or twenty-three meshes to the yard. Pilchard drift-nets, principally used on the coast of Cornwall—for the pilchard is essentially a Cornish fish in this country—are about the size of those used for herrings, but with a slightly smaller mesh; in fact, shrunk herring nets are frequently used in the pilchard fishery when the meshes have become too small for their original purpose.

Drift-nets are occasionally used in deep water estuaries for the purpose of catching salmon, but practically they are employed only in the open sea; and a very large proportion of the enormous numbers of herrings, mackerel, and pilchards, which are annually caught around our coasts, are taken by means of these nets.

THE SEINE OR SEAN.

The sweep-net, commonly known in this country as the seine or sean, is one of the oldest implements of fishing of which we have any record, for there is evidence of the seine or draw-net having been in use by some nations long before the Christian era; and in the New Testament we read of fishing having been carried on by some of the men who afterwards became Apostles, in a manner which agrees entirely with our present mode of working the seine. It was well known to the Greeks and Romans, and in this country its history in Cornwall dates back so far that it is believed to have been introduced by the Phœnicians, who were accustomed to use this net, and who at a very remote period traded for tin and other things to that part of our country which is now known as Cornwall. Seines are worked on various parts of our coasts, and in rivers and other inland waters; in fact, they may be used almost everywhere if there is a tolerably smooth bottom, and sufficient room to cast out the net in a sweep or semicircle, or it may be used at some little distance from the shore as a circle-net. For ordinary sea fishing seines may be divided into three classes, namely, the circle-net or seine, the tuck-seine, and the ground-seine. The two first are especially used in the Cornish pilchard fishery, and as that is of considerable importance, we will give some account of the nets employed in it. We may first mention, however, that all these nets are used for surrounding or encircling the fish. They consist of a long train of netting varying considerably in dimensions, but are always of greater depth at the middle or "bunt" than at the ends, which are called the "wings" or "sleeves," and they are shot in a circle if the net is to be worked entirely from a boat, or in a semicircle if it is to be hauled on shore. The back or upper edge of the net is buoyed up by corks to keep it at the surface, a point of great importance, as the net is principally used for catching surface-swimming fishes, such as mackerel, herrings, and pilchards; and the foot is weighted with lead to keep that part of it down, so that it may hang perpendicularly in the water. At St. Ives and a few other places on the Cornish coast pilchard-seining is carried on more or less every year, depending on whether the fish come into certain bays which, for many years past, have been so often visited by the shoals of fish that it has been worth while to keep a number of seines there in readiness for instant work when the fish make their appearance. Two, or sometimes three nets are employed there for enclosing a shoal of fish, or as much of it as can be managed at the time. The first or principal net, there called the "seine," is about two hundred fathoms long, and ten fathoms at its greatest depth; to this another net of the same kind, called the "stop-seine," is fastened, and the two are shot together, each boat with its own net, starting from the same place, rather on the outside of the shoal of fish, if it be not very large, but moving in different directions, although with the intention of ultimately reuniting. It may be mentioned that men called "huers" are stationed on the hills surrounding the bay, and signal to the men in the boats the direction the fish are taking, the appearance of the water over the fish plainly showing to these men what their course is. The seine is at first carried along outside the shoal, parallel with the shore, and then brought round towards it, thus cutting off as large a portion of the shoal as the net will compass, whilst the stop-net, which is fastened to the other, is shot at a right angle to the large seine and towards the land, across the course of the fish, so as to stop them. If one stop-net is not long enough for the purpose, a second is joined to it, and the ends of this and of the large seine are gradually hauled towards each other on the shore side till they meet, and the fish are entirely surrounded. The circle is then gradually contracted by taking out the stop-nets, till the whole catch is enclosed within the single large seine, the ends of which are at once fastened together. The whole concern is then slowly hauled towards the shore, into some quiet part, out of the run of the tide, if possible, till the foot of the net touches the bottom, and there it is securely moored with anchors on every side, and the upper edge with extra buoys. The advantage of having the bunt or middle of the seine deeper than the wings will be obvious when it is remembered that if the foot of the net does not touch the ground all round, the fish may escape underneath; and as the shore is always more or less shelving, a greater depth of netting is required for the deeper water. Such an enormous body of fish has been sometimes enclosed by one operation of the seine that it has taken a week to land them; and even with more moderate captures two or three days may be required. It is necessary therefore in the first place to have the net and enclosed fish securely moored. The next operation is "tucking" the fish or taking them out of their net prison. This is done with the tuck-seine, a net only seventy or eighty fathoms long, but very deep at the bunt or middle. It is shot inside the circle formed by the large seine, and as the two ends are hauled into the boat the bunt is gathered up so as to bring it under the fish and raise them to the surface, when they are dipped out with large baskets and put into the boat to be taken on shore. The circle made by the large seine is gradually contracted as the fish are taken out until the whole catch has been landed, and the nets are then taken on shore. If the shoal of fish is apparently a small one, then perhaps only a single net may be used, and the enclosed fish are at once tucked into the boat.

The seine when used in this manner in Scotland is called a circle-net, and seine-fishing in general is there spoken of as "trawling"—an unfortunate expression which has led to great confusion among writers on the fisheries, as the so-called "herring-trawl" is entirely different in its construction and mode of working from those nets which in England and Ireland have always been properly called trawls. It is very difficult to induce fishermen to give up using a name they are accustomed to; but if the Scotch fishermen alone, among the fishermen of the United Kingdom, cannot be persuaded to call a seine by its proper name, it would at least simplify matters and prevent confusion if, instead of calling it a "trawl," they would generally adopt the more intelligible name of "seine-trawl" for this net.

The commonest form of seine is that usually known as the ground-seine or foot-seine, sometimes called a scringe-net. It is in very general use, for it can be worked without any difficulty, and even when of very small size may be the means of catching a fair variety and number of fish. The peculiarity in its working is that it is always hauled in on shore, and, that being the case, there is no necessity for the wings to be made of such fine netting as is desirable at the middle or bunt where the fish sooner or later collect, and the greatest pressure is felt. Each wing has an upright pole to which the ends of the upper and lower edges—the back and the foot—of the net are fastened, and to this pole a long drag-rope is attached for the purpose of hauling in the net. When the seine is to be shot the end of one of the drag-ropes is left on shore in charge of some of the fishermen, and the whole of the net with the rope at the other end is put into the seine-boat, which is then rowed out from the shore, and after shooting the net in a semicircle, returns with the second rope to the beach. The two ropes are then slowly hauled in, the two parties of fishermen, one at each rope, gradually approaching each other as the seine comes to land until at last they meet, and the bunt of the net in which all the fish are collected is then drawn on shore. As the ground-seine may be made of very moderate dimensions it is very convenient for amateurs who may not be able to muster hands enough to work a large net. It is therefore frequently used by yachting men in the harbours they are in the habit of visiting, and it can be easily worked, as we have said, wherever the bottom is tolerably smooth and there is a bit of beach on which the net can be landed. It is employed in precisely the same manner in fresh or brackish water for salmon fishing within the mouths of rivers. As might be expected from its antiquity, it is used in almost all parts of the world, and in some countries is made of such a large size as to occupy two hours or more in making a single haul.

The casting-net is another very ancient implement of fishing, and although in this country it is little employed except in fresh water and for the purpose of catching small fish for bait, it is well known in many parts of the world, and we have often watched the native fisherman on the Ceylon coast advance almost waist-deep in the sea, and then throw his net into a heavy breaker as it curled over on the shore, and catch eight or ten fish of perhaps two or three pounds weight each of a kind that delights in those great rolling seas which month after month keep up a continuous roar on that stormy coast. The net is a circular one about sixteen feet in diameter, weighted with lead all round the margin, and it is thrown in such a manner that although, when ready for casting, it is held by the centre and the sides are all folded together, the act of casting, when skilfully done, spreads the weighted margin into a circle which covers a considerable space as it falls, and then the weights bring the edges together and are drawn close so as to secure whatever fish may have been covered by the fall of the net. In some nets the edges are brought together by means of a line; but the native fisherman has no fear of wetting his skin—he has little clothing on such occasions to think about—and boldly faces the breakers, springing up as the sea threatens to take him off his feet and gathering in the net with his capture as if it were—as in fact it is with him—a most ordinary proceeding.

SHRIMPING.

This kind of fishing is carried on either by hand-nets or some form of trawl. The hand or "shove-net" varies a little in shape on different parts of the coast, but it may be described generally as a large shallow semicircular or triangular net, extended in front by a light wooden scraper eight or ten feet long, into which a handle or pole of the same length is fixed at right angles. The net extends from the scraper to within two or three feet of the farther end of the pole, and generally has a pocket of netting below it at that part.

This net the shrimper pushes or shoves before him as he walks through the shallow water over the sands where the shrimps abound, and he every now and then raises the scraper that the shrimps in the net may be thrown back into the pocket. On the Thames a net of quite a different construction is used, and is worked generally two at a time from large sailing boats. In general form the Thames shrimp-net resembles an ordinary trawl such as has been previously described, but instead of the under part being cut away in a curve, it is quite square with the front of the upper part, which has a light pole across it corresponding to the beam of the beam-trawl. This Thames shrimp-net consists, in fact, of a triangular purse-shaped net, like a trawl, the lower part of the mouth being fastened to a flat wooden scraper weighted with lead, and about ten feet long, instead of having a ground-rope; and parallel to it, and supported by an upright stick a foot and a half long, fixed in the middle of it, is a pole six feet long, to which the upper side of the net is fastened, as in the beam-trawl, the pole and the scraper being kept square by ropes leading from the one to the other at their extremities. Trawl-heads are not required here, as the upright stick keeps the mouth of the net open. The net itself is about twelve feet long and tapers rapidly to the cod-end. The meshes are necessarily very small in order to retain the shrimps, and are made of three sizes, ranging from half an inch square at the mouth of the net to a quarter of an inch at the small end. A simple but ingenious plan is adopted to prevent stones and small rubbish entering the net whilst it is being towed over the ground, and at the same time not to interfere with the capture of the shrimps. It is founded on the observed habit of these animals to rise a few inches from the ground when they are disturbed, and consists in leaving an open space of two or three inches between the lower edge of the mouth of the net and the beam or scraper to which it is fastened. Through this opening, sand, seaweed, and such small rubbish as is likely to be met with on the shrimping ground, easily pass, whilst the shrimps spring above the gap, and find their way into the net. A three-span bridle from the two ends of the lower beam or scraper and the top of the central stick is made fast to the warp by which this shrimp-net is towed. The shrimping boats are small-decked smacks about thirty-two feet over all; they carry a good deal of lofty sail, and are no doubt familiar to all who are in the habit of visiting the mouth of the Thames, where, in the early part of the summer especially, a large fleet of shrimpers may generally be observed at work. Two and sometimes three of these nets are used by each boat, and they are kept down from a quarter of an hour to an hour at a time, depending on the wind and the extent of ground they have been over. The shrimps are sifted as soon as caught, and those of the size permitted to be landed under the regulations of the Thames Conservancy are at once put into the boat's well to be kept alive until they are taken on shore in the afternoon. They are then boiled and sent off by train from Leigh—the great headquarters of the Thames shrimpers—in time for the London market the next morning. Large quantities of shrimps are thus procured from the Thames, and as many as 2000 gallons are sometimes sent thence to market in one day. Prawns or "red shrimps" are also taken in some parts of the estuary of the Thames by means of small trawls of the ordinary construction; but the prawns thus caught are usually small, and the fine large ones, which are sold by the dozen, instead of by the pint or quart, are taken in more rocky situations by means of hoop-nets which are set in suitable localities, and are baited with fish fastened to the centre of two cross lines on the hoop. Another contrivance for capturing these large prawns is a sort of cage of the same kind as is used for catching crabs, and which will be described presently.

FIXED NETS.

The nets we have now to notice, although of somewhat varied forms, possess this character in common, that they are fixed to one place, and are either secured by means of anchors, or are fastened to stakes driven into the ground. They are used in both the open sea and in estuaries or the mouths of rivers; and being fixed, they must of course depend for their successful working on the fish finding their way into them, either by chance or by having their course directed towards them by the set of the tide or other means. The most remarkable of them is the gigantic bag-net known as

THE STOW-NET.

This enormous bag-net, exceeding in length the largest beam-trawl, is exclusively used for catching sprats. Numbers of these nets are employed every winter at the mouth of the Thames, in the Solent, and in the Wash on the east coast of England. The season for working them is from November to February, at which time the sprats make their appearance in countless myriads on certain parts of the coast, and nowhere more abundantly than at the entrance to the Thames. The net has the shape of a long, narrow funnel with a nearly square mouth, the opening or entrance being thirty feet from the upper to the lower part and about twenty-one feet wide. From this it tapers for a length of ninety feet to a diameter of five or six feet, and further diminishes to nearly half that size in the remaining part of the net, which is also about ninety feet long. The whole net is therefore about a hundred and eighty feet, or sixty yards in length. It is divided into several portions, the first being called the "quarters," as it is composed of four distinct pieces of netting corresponding to the four sides of the mouth; the next portion is called the "enter," and forms the last part of the most funnel-shaped portion of the net. The remainder of the net, which tapers very gradually, is made up of from two to four divisions, the last one being called by the names of the "cod," "dock-hose," or "wash-hose," and the intermediate portion or portions the "sleeves;" the number of sleeves inserted in the net depending very much on whether there is a prospect of the fish being abundant or otherwise. The meshes vary in size in different parts, diminishing from an inch and three-eighths near the mouth to from half to three-quarters of an inch at the smaller end, there being a slight enlargement of the meshes in quite the last part of the net. The dimensions here given of a stow-net are those of such as are in general use, but they vary a good deal in size, and some are much smaller than others. The way in which the net is used is very simple. The boat or vessel—small smacks which at certain seasons in the year are engaged in oyster-dredging are commonly employed in winter in what is called "stow-boating"—takes up a position at the beginning of the tide where there are signs of fish, or in localities where the experience of previous years teaches the fishermen to look out for the shoals. She then anchors, and at the same time the net is put overboard, and takes its proper position at a certain depth immediately under the vessel. In order that this may be effectively managed, a rope is made fast by one end to the anchor of the fishing boat before it is dropped; the other end is fastened to four ropes leading each to one corner of the square mouth of the net, thus forming what is called a double bridle; and to facilitate the mouth of the net being kept open when set in the water, two wooden spars or "balks" are fastened to the mouth of the net, one on the upper side of the square and the other at the foot. More than this, however, is necessary to keep the mouth properly open, and this essential part of the arrangement is provided for by having a rope from each end of the upper balk to the corresponding side of the vessel, and by weighting the lower balk in order to sink it. When, therefore, the vessel has taken up her position for fishing, both vessel and net are moored by the same anchor, and the depth at which it is thought best for the net to remain is regulated by the ropes from the ends of the upper balk leading to each side of the vessel. The strain on this enormous bag-net by the force of the tide is often very great; but the net, being held by the same anchor as holds the vessel, both keep in the same relative position, even if the combined strain on both should cause the anchor to drag. In this position then, the vessel and net remain till the tide has nearly done, the sails being all taken down, and only one man left on deck as a watch to see when it is getting slack-water and to keep a general look-out. It will be understood from what has been said that while the vessel, and the net straining away under her, are thus anchored, the shoals of sprats are being brought with the tide to the mouth of the great funnel-shaped net, and, of course, myriads of them are carried into it, and by the constant pressure of the water are ultimately driven to its farthest end, from which there is no chance of their getting out until the net is taken up. As soon as the tide is becoming slack, shortly before turning, all hands prepare to haul up the net. The first thing to be done is to close the mouth of the net so as to prevent the possibility of any of the fish escaping. This is effected by means of a chain fastened to the middle of the lower balk at the foot of the square mouth, and leading through an iron loop at the middle of the upper balk upwards to a small davit at the bow of the vessel. By heaving in this chain the two balks are brought close together, and ultimately hoisted above the surface of the water under the vessel's bowsprit, the net with all the contained fish streaming away alongside and astern of the vessel. The net is then hauled on board by a long-handled iron hook, and overhauled till the cod or end of it is reached. This is then hoisted in by means of a rope which has been fastened to the end of the net all the time it has been in the water, and by which the extremity of the net has been kept closed. This rope having been cast off and the end of the net consequently opened, the sprats are turned out and measured into the vessel's hold, in quantities of about three bushels at a time, the master superintending the work, and using a kind of wooden hook, called a "mingle," to hold the net in such a manner that only a certain quantity of fish shall pass out at once. In this way all the fish there may be in this long tube of netting, which the free end of the net really is, are worked through it into the vessel's hold. Often, when the sprats are very abundant, many tons of these fish are taken by one of these nets during a few hours. "Stow-boating," as this kind of fishing is called, is carried on both by day and night during the season; and the quantity of sprats thus taken is so enormous as often to glut the markets, and then the surplus, consisting of hundreds of tons, are sold at very low prices to be used as manure. A smaller net of the same general character, but with a triangular instead of a square mouth, and called a trim-net, is used at the entrance of some small streams running into the Wash, and several kinds of small fish are there taken in it. A still smaller net of the same description is used on the Thames for catching whitebait, which should be pretty well known now to be nothing but young herrings. Very small sprats are also often caught with them; but when they are brought to table they all do duty as "whitebait." So difficult, however, is it to get rid of popular delusions that we will venture to prophesy that at any time within the next fifty years, or perhaps longer, the question as to what the whitebait is will be brought up and discussed in the newspapers with as much earnestness as if it were an entirely new problem, and treated in perfect ignorance of its having been shown that, after the most searching examination, no difference can be discovered between very young herrings and the most orthodox whitebait.

TRAMMELS OR SET-NETS.

Although the nets we are now going to speak of agree in the special character of being anchored or set, there is considerable variety in the size of their meshes and the purposes for which the nets themselves are used. The true trammel is a combination of three nets placed side by side, and its name is derived from the Latin *tres maculæ*, signifying three meshes, represented by the French words *trois mailles*, having the same meaning; from these comes the French compound *tremail*, or the modern word *tramail*, and the English word trammel has evidently the same origin. The trammel, then, is made up of three long nets placed side by side, and fastened together at the top or back, the foot, and ends. Each of the outer nets or "wallings" has a depth of five meshes ten inches square, and is forty or fifty fathoms long. These two wallings or outer nets are so mounted or arranged that the meshes of both exactly correspond in position, and a fish might pass through them as if they were a single net. The third net, however, is placed between the other two, and has meshes only two inches square; but it is twice as long and as deep as the outer ones, the extra netting being gathered in at short intervals along the edges where the three nets are fastened together. The consequence is that there is a large quantity of slack netting between the two outer nets. The object of this will be shown presently; but, thus prepared, the trammel is ready for use, and is set at the bottom with its length in the direction of the tide, never across it. It is anchored and buoyed at each end, the back or upper edge being well corked, and the foot weighted to keep the whole length in a proper position. Thus set, the trammel stands like a wall in the water, just the same as a drift-net, but fixed to one place at the bottom instead of moving along near the surface with the tide. The action of the trammel is quite peculiar among fishing nets. The outer nets or wallings stand with their meshes fully open and exactly opposite each other, with the small-meshed net between them: and a fish, in trying to pass through the first one, meets the second, which is very slack, and carries a portion of it through the third net, thus producing a bag or pocket beyond it. The more the fish struggles in this bag the more it becomes "trammelled;" and sometimes in its efforts to become free, it carries the pocket back through the adjoining large mesh, making its case still more hopeless. The advantage of a walling on each side of the slack net is twofold; it obliges the fish to strike it just where it can be forced through the large mesh beyond it, and it makes the trammel equally effective if the fish strike it on one side or the other. It is very much used at Guernsey for catching the red mullet, for which that island is celebrated; and many yachting men, in these days when so many people have a turn at sea-fishing on their own account, carry a trammel on-board-ship for use when they find a suitable locality for working it in. Professional fishermen in this country, however, do not very readily take to this particular kind of net. Set-nets of a more simple description, but in many places called trammels, are in general use for catching several kinds of fish. They are, however, only single nets, anchored and buoyed in the same manner as the true trammel; but, whilst the back and foot of the net are kept tight, the body of netting is set rather slack, and the fish are caught in it by being meshed just as in a drift-net. Herrings, hake, turbot (on some parts of our eastern coast still called by the old name of "bratt"), and skate among unlikely fish are thus taken; and under the name of "gill-nets," this particular kind of net has for the last few years been largely used instead of lines for the capture of cod by American fishermen. We hear, however, that gill-nets have caused some disappointment as they can be worked with advantage only at the season when the cod are found in shoals, and now a great number of these nets would be gladly disposed of by their owners, who are returning to their accustomed mode of fishing.

Fixed salmon-nets may be more properly noticed farther on under the head of Traps.

LINE-FISHING.

We now come to what is probably the oldest known method of fishing, with perhaps the exception of some form of fish-spear, which, from the fact of spears being used by savage nations generally as one of the weapons of warfare, were no doubt readily adopted also for the purpose of striking at and killing such fish as passed within reach. Fish-hooks, however, of a very primitive character, and made either of bone or shell, were invariably among the curiosities brought home by the early exploring expeditions to the South Seas; and so universal now is the use of the hook and line for fishing, that the manufacture of fish-hooks has become an important industry in many countries, and numerous varieties of shape, size, and material bear witness to what in some cases may be thought to be the fastidiousness of anglers and the attention that is being given to supply their wants. Line-fishing at sea is, however, comparatively simple work, requiring but little of the skill so often needed for the more delicate operations in fresh water; and although in many cases greater success undoubtedly attends the use of finer tackle and more varied baits than tradition and example have led most of the professional fishermen to adopt, a knowledge of the localities frequented by the different kinds of fish at the various seasons is generally the most important part of the fisherman's education. In one form or other line-fishing comes within the reach of all classes, and the scale on which it is worked by our sea-fishermen depends more on capital and locality than on any essential difference in the kind of gear or the manner of using it.

There are two principal methods by which our line fisheries in salt-water are carried on, namely, by long-lines and hand-lines. Both are very simple in their character, and a short account of each as practised on a large scale in this country will probably be sufficient for their explanation, as the general subject must be more or less familiar to all who have either visited or resided on the coast.

The long-line, spilliard, spiller, bulter or trot, all of these names given to the same kind of line, according to locality, size, or the purpose for which it is used, is a very general means of fishing, as many kinds of valuable fish are caught by it, and any length that is convenient may be worked. It is extensively used far out in the North Sea and on the northern coasts of our islands, for the capture of cod, ling, holibut and haddocks, and some of these fish, especially cod and haddocks, when taken by hook and line, have a better appearance and command better prices in the market than when caught by the beam-trawl. In Scotland the haddock is highly esteemed, being regarded as one of their best fish, and these are all caught by the line.

We may here mention, to prevent confusion, that the long-lines we are now speaking of are on the whole west coast of the North American continent called "trawls," the fact that the word "trawl" is the same as to "trail or drag along" being entirely lost sight of. As the long-line is anchored at both ends and at intervals along its course when in use, it is evident that no more unsuitable word than "trawl" could be applied to it.

The most important long-lining in this country is carried on from Grimsby by large smacks, which mostly fish for cod in the neighbourhood of the Doggerbank in the North Sea. These vessels carry from nine to eleven hands each, and remain at sea until they have a fair cargo of fish, which are kept alive as long as possible in a well built in the vessel. The construction of this well will be explained presently, and we will now say a few words about the long-line itself.

A complete set of long-lines, as used in one of these vessels, consists of about fifteen dozen, or 180 lines forty fathoms in length, each supporting twenty-six hooks on smaller short lines called "snoods;" these are fastened to the main line at a fathom and a half apart, that distance being sufficient to prevent the snoods fouling one another and the hooks becoming entangled. A "string" of this description, made up of the 180 lines all fastened together into one is 7,200 fathoms long, equal to more than seven nautical miles, or about eight ordinary ones, and has 4,680 hooks. The bait used on these lines is the common large whelk, which is an attractive bait for cod and ling, and from its toughness and substance is not so easily worked off the hook, as that more favourite bait with fishermen generally, the common mussel. The operation of baiting so many hooks of course takes up a good deal of time, and gives plenty of occupation to the numerous hands on board before this great length of line can be shot. Long-lining by these vessels is only carried on during the day, as light is wanted to enable the men to see what they are about when hauling in the line and taking off the fish. The lines are therefore shot about sunrise, or earlier if the weather is fine, and it is not very dark, and sometimes a second shot is made if there is time in the course of the day, but they are always hauled up before night. They are laid across the tide so that the snoods, or short lines to which the hooks are fastened, may drift clear of the main line. When a "shot" is to be made, the smack is put under easy sail, and kept as much as possible with the wind free, so as to lay out the line tolerably straight. In some parts of Scotland, however, the opposite course is adopted, the fishing boat being sailed against the wind when putting out the lines. In either case the line must be shot across the tide, and the local custom is not very material. With such a large number of hooks to deal with, of course great care is necessary to prevent entanglement, and accordingly the lines are neatly coiled, and with the baited hooks are laid in trays all ready for running, each tray containing from twelve to sixteen pieces of line, and they are paid out one after the other as the vessel sails along, until the whole length of line is overboard. No corks or floats of any kind are here used to raise it off the ground, but the line is kept steady at every forty fathoms by a very small anchor, and its position at the two ends and at every intermediate mile is marked by a conical hooped buoy or "dan," with a light pole or staff passed through it, and carrying a small flag at the top. The line is usually shot at half-tide, and when the operation has been completed, the smack heaves to in the neighbourhood till the tide has nearly done running. Then the hauling up begins. The foresail of the smack is lowered, and the end buoy being taken on board, the vessel makes short tacks along the course of the line, which is shown by the buoys placed at every mile; the line is hauled in as the vessel works along, and the fish are taken off the hooks as fast as they come in. Sometimes the line is hauled into the smack's boat, which is about 18 feet long and very roomy; and in this a watertight compartment is built, in which the fish are kept alive until the boat returns to the smack. But this plan can only be adopted in very fine weather, as the water far out in the North Sea is not often smooth enough for it to be carried out satisfactorily. As cod are not only the most valuable fish taken on these lines, but command a specially good price, everything is done to ensure their reaching the market in the finest possible condition, and this can be best accomplished by keeping them alive. They are accordingly placed in the vessel's well as soon as possible after being taken off the hook, having first undergone the operation of puncturing the air-bladder or "sound," which, apparently from the long struggles of the fish to get clear of the hook, becomes unusually inflated, and would often keep it floating in an unnatural position at the surface if it were put into the well in the condition in which it came off the hook.

The use of welled vessels for keeping the cod alive was first tried in this country in 1712, at Harwich, a port for many years famous as the head-quarters of the home cod-fishery, and still used as a station, although Grimsby has in recent years become the great centre of the English cod supply. It is said that the idea of wells on board ship was taken from the Dutch fishermen; but it has long been adopted in this country with particular advantage to the cod fishers. "Welled smacks," as they are called, are specially constructed for the purpose, the well not being a large tank fitted into the vessel, but a part of the smack itself. Two strong watertight bulkheads or divisions are built entirely across the vessel from keelson to deck, enclosing a large space in the centre of the vessel; this is the "well," and a constant supply and circulation of water direct from the sea is kept up through large auger holes bored in the bottom of the vessel at various distances below the water line. The entrance to the well is through a hatchway leading from the deck for a short distance downwards, where it opens in the "well-deck," which covers the whole upper part of the well except the opening just mentioned. The object of this lower deck, placed as it is a little above the water-line, is to keep the level of the water within certain limits when the smack is rolling about or pressed down under sail; it also helps to prevent the water splashing up through the hatchway on the main deck. Cod are the principal fish put into the well; and when they have been caught in only a moderate depth of water they thrive better than those taken at greater depths. There is some mortality, however, among the best of them, arising from their being knocked about in the well during bad weather. This cannot be altogether prevented when there are many fish on board; but they are taken out at once and packed in ice, and each line-smack on returning to port generally has a number of such fish preserved in that manner, including also cod, ling, and haddock, which were not thought likely to live in the well when they were taken off the hook. It is no uncommon thing for a smack to return from the Dogger with from twenty to twenty-five score of fine live cod, besides perhaps two-thirds of that number of fish in ice.

The season for long-lining is during the winter months, and the fishing is carried on from November to March or April, depending partly on what ground the smack is at work. The great enemy the cod-fishermen have is the dogfish, which at certain times, but fortunately not every year, commit great havoc among the cod which have become hooked. One case is recorded of nearly every fish on the line having been more or less eaten by the "dogs," and the smack returned to harbour with her rigging covered with skeletons. Of six and a half score of cod on the line only six fish were found alive. The clearer the water the more danger there is from dogfish, as the cod can then be seen at some distance when struggling on the hook, and once having attracted attention there is little hope of escaping their enemies.

We have so far spoken only of the manner in which the cod are caught, but a few words on their treatment when they are brought into port may be of interest. When the smacks arrive at Grimsby with their cargoes of live and dead fish, the cod are taken out of the wells by means of long-handled landing nets, and are placed in wooden boxes or chests, which are kept floating in the fish-dock; and there the fish are stored till they are wanted for the market. Each chest is seven feet long, four feet wide, and two feet deep; the bottom is made of stout battens a short distance apart to allow free admission to the water, which also has access through the sides and ends between the planks of which they are constructed. The top is wholly planked over except in the centre, where there is an oblong opening for putting in and taking out the fish, and which is closed by a cover when the chest is afloat and in use. Two rope or chain handles are fixed at the ends of the chest for convenience in moving it about and hoisting it up from the water. These chests will each hold forty good-sized cod, or a proportionately larger number of smaller ones, and the fish do not show any material loss of condition if they are thus imprisoned for about a fortnight. As many as from 15,000 to 20,000 live cod are sometimes stored at one time in the Grimsby fish-dock. But the time comes when the fish are wanted for the market, and must be taken out of the chests and sent away by rail. This happens every day during the cod season from some of the stores, and then a remarkable scene takes place, and one peculiar to Grimsby and Harwich—the latter being also a storing place for live cod. A chest of fish is towed alongside an old hulk kept for the purpose close to the quay of the fish-market, and is hoisted just out of the water, which drains through the bottom of the box and leaves the fish dry. The cover is then taken off, and a man gets into the opening and takes out the fish, seizing them by the head and tail. The commotion amongst perhaps forty or fifty cod just out of the water is of course very great, and it is often no easy matter to get a firm hold of them; but, one after another, they are lifted out and thrown upon the deck of the hulk, where they are taken in hand by another man who performs the duties of executioner; he grasps the fish tightly behind the head with his left hand, holds it firmly on the deck, and giving two or three heavy blows on the nose with a short bludgeon, kills it at once. It is sometimes a difficult thing to hold a large and lively fish by one hand, but the work is generally skilfully performed, and the dead fish rapidly accumulate into a large heap, whence they are taken on shore to be packed in bulk in the railway trucks waiting close by to receive them. Each truck will hold about twelve score of good-sized fish, and they are sent off so as to arrive at Billingsgate for the market the next morning. Such fish are known in the trade as "live cod," and command the best prices.

Long-lines are used on various parts of our coasts for catching several kinds of fish, and in parts of Scotland the deep-sea lines are known as "great-lines" as distinguished from the smaller ones employed nearer the land for catching haddocks. In the Shetlands long-lines are used entirely for the important home fishery for ling and tusk, the latter a northern species of the cod family intermediate in shape between the ling and the cod, but very much smaller than either of them. The boats used by the Shetlanders are the famous Norway skiffs, in almost every respect the same as whale-boats; they are about twenty-eight feet over all, and eight feet beam, and, wonderfully handled as they are by their crew of six men, they face a good deal of bad weather and go long distances from land. They are called "haaf" or deep-sea boats.

Hand-line fishing is carried on almost everywhere around our coasts, and with every variety of tackle, according to the kind of fish worked for. Cod-fishing by hand-line in the North Sea commences in July and is carried on till near the end of October, when the fishermen prepare for the winter fishery by long-line already noticed. The same smacks are used for both, but hand-lining is worked only a few miles from the coast, as the cod come inshore after the herrings, which at that time are making towards the land. The gear employed is a stout line 45 fathoms in length, fastened to a long leaden sinker of from 5½ to 7 pounds weight, with a strong iron wire called the "sprawl-wire" fixed in it near the top at right angles to the body of the lead and slightly curved downwards at the ends; to each of these a snood of smaller line six feet long is fastened, and supports a large cod-hook twice the size of those used on the long-line, as with these hand-lines nothing but cod is generally taken, whereas on the others haddock and other smaller fish are caught, and themselves often serve as living bait to attract the cod. The hook on these large hand-lines is often fastened to the snood by means of a bunch of open strands of soft twine about three inches long, so that the fish cannot bite through the line, the teeth passing between the strands without injuring them. Whilst hand-line fishing the vessel is hove-to, and each of the crew works one line, keeping the baits a few inches from the bottom, unless the herrings are about, as then the cod come nearer the surface, and it is often only necessary to allow one or two fathoms of line. It is found that the fish do not bite very freely during a great part of the day, so that it is not necessary for everyone to be at work till towards sunset; then all hands are kept fully employed. The cod are put into the well as soon as caught, just as in the case of long-lining. In the Channel, and especially on the Devonshire coast, there is an important fishery for whiting during the summer months, and this is carried on entirely with hand-lines, but with smaller lines and hooks, and with leads varying in weight according to the strength of the tides. In whiting-fishing the boats come to anchor, and the fishing is begun at some few miles from the land, the fish coming closer in as the summer advances. On the other hand, mackerel-fishing is, as a rule, carried on when the boat is moving well through the water; lines with boat-shaped or short pear-shaped leads being towed after her. When a light lead is used from a rowing boat, the method of fishing is called "whiffing," and working with a heavier lead from a sailing boat "railing"; but practically there is little difference but the weight of the lead between the two modes of fishing. In the west of England it is the practice with the fishermen in the small sailing boats they work in to have a pole projecting on each side of the boat and to these the lines are fastened, an in-haul to each enabling the line to be brought on board. With these contrivances the lines can be more spread and an additional number used. Another mode of line-fishing is by a plan perhaps better known in freshwater fishing than in the sea. The line is properly called a "paternoster," and has a leaden sinker or plummet of varying weight according to the kind of fishing to be done. On some parts of the Scotch coast this line is called a "dandy-line" or "jigger," and has a weight of four pounds at the end, whilst above it, at intervals of eight inches, pieces of whalebone or wire nine inches long are fastened across the line, having at each end a short bit of fine line supporting a bright tinned hook. Eight or ten of these spreaders are thus fastened at the middle to the line, and the whole apparatus is lowered to the bottom and then gently moved up and down. In this case no bait is used, the bright hook proving a sufficient attraction to the herrings for the capture of which it is employed. It is, however, not in very general use for this purpose. When used for fishing in fresh water the paternoster is made of a few feet of gut-line with a small lead at the end, and short pieces of gut fastened at intervals to the line in such a manner as to stand out clear of it. The hooks are at the end of these short pieces, and in perch-fishing, for which it is chiefly used, live minnows are employed as bait. The apparatus is worked with a short rod, and in much the same manner as its coarser representative, the dandy-line. Cross-lining is a mode of fishing carried on in rivers by means of a line fitted with a number of hooks on short pieces of gut fastened at intervals along it, the bait used being the artificial fly of some kind. It is on the same principle as the long-line used in salt water; but in this case the line is extended and worked by two rods from boats on opposite sides of the river, and of course at or near the surface. The same kind of fishing is managed by a person on one bank of the river by means of an otter-board at the other end of the line, and which, by its peculiar action, as described in our account of the otter-trawl, keeps the line extended as the fisherman walks along the bank up-stream. Both these methods are considered as rather poaching devices, but they are too well-known for this short notice of them to increase their employment. The various other and more recognised methods of fishing with rod and line in fresh water would require more space than we have at our command to give even an intelligible sketch of; for it may be fairly said that from fly-fishing for trout and salmon to the humble yet lively sport of gudgeon-fishing, there are niceties in rods and tackle, and in the ways of using them that can only be properly understood after plenty of practical instruction and experience. Angling, as we said at the beginning of these pages, is mainly connected with sport and amusement; and the large and varied exhibition here of rods, lines, arrangements of hooks, winches, and artificial baits of different kinds, tells plainly that the sport in its true sense means the exercise of such skill in the gentle art as can usually be acquired only by years of practice.

Baits.—In sea-fishing the variety of baits used is by no means so great as might be supposed. In the North Sea cod fishery of which we have spoken, the principal bait in request is the common whelk or "buckie," and so great is the demand for them that several small craft from Grimsby are regularly employed in procuring them. The mode of catching them there adopted is by shallow hoop-nets baited with refuse fish, and sunk to the bottom in likely places. In these hoop-nets, the top of which is partly covered with netting, the whelks collect in large numbers, and are caught without difficulty. Another more elaborate method is that called "trotting." The trot is only another name for a long-line of small dimensions; but instead of having baited hooks, common green shore-crabs are threaded on the snoods or short pieces of line, about twenty on each snood, and the whelks, which are carnivorous in their habits, seize and keep as firm hold whilst devouring the crabs, as if they were hooked, and when the line is hauled up the snoods are found covered with whelks. This fishing for whelks, besides contributing so largely to the capture of cod and other fish, results in the diminution of one of the most inveterate enemies of the oyster and mussel, and thus performs a double service. The bait, however, of all others the most in request for general fishing, is the common mussel; but it requires some care in putting it on the hook to make sure of its remaining there; it is therefore generally used when the fishing boat is at anchor, or when the line itself is fixed. For this reason also it is frequently employed on long-lines, and in such cases may attract good-sized fish, or if only small ones, the latter may themselves become converted into living bait for their larger brethren. It is a curious circumstance that the two baits which appear to be specially attractive to fish are to be found in the mussel and the whelk—animals which are naturally so well protected by their shells that they can rarely become the prey of cod and other kinds of fish. Of baits made of portions of fish there is not a great variety in use. Pilchards in the west of England are often used as bait for whiting, and prove attractive to several other kinds of fish. For mackerel of course everyone who has had an opportunity of fishing for them is familiar with the "lask" or slip cut from near the tail of that fish, and so excellent a bait. Its attractiveness is evidently due to its resemblance to a small silvery fish glistening in its passage through the water. A mackerel strikes across the line of the bait, hence anything that readily catches the light and attracts attention, even for a moment, is likely to be effective. There is no other explanation of the success which so often attends the employment of an old sixpence or a bit of the white stem of an ordinary pipe as a bait on a mackerel hook. Sand worms of more than one kind are in favour, especially for pollack, and for various kinds of fish no bait is more attractive than the living sand-eel. This little silvery fish is the favourite bait, living or dead, with the fishermen at Guernsey, and is coming into use on parts of our own coast. Among other attractions offered to the fish which frequent our coasts are the tail of the hermit or soldier-crab, and squid or cuttle-fish, the latter used in many parts of the world, and valuable on account of its toughness. In recent years many artificial baits for sea-fishing have been invented, all of them intended more or less as imitations of such natural baits as have proved to be generally attractive. The same principle applies to the multitude of artificial flies and other imitations used in freshwater-fishing, but we believe the original of the gaudy salmon-fly has still to be discovered. The use of artificial baits is, however, by no means confined to this country, and we have often successfully fished on the coasts of Ceylon, with an extraordinary combination of cocoa-nut and fibrous bark tied on the roughest description of hook; and this bait, in supposed imitation of a flying-fish, is the one in general use there for catching the seir-fish—a very large species of the mackerel tribe, and one of the best fishes for the table which are met with in the Indian seas.

FISH-TRAPS.

Some account having been given of the largest and most important methods of fishing, we propose now to say a few words about those kinds which hold a less conspicuous position, although in the aggregate contributing a fair proportion to the market supply of food, and giving occupation to a great variety of people. So many of the contrivances used in the smaller fisheries have so essentially the character of "traps;" in other words, forms of apparatus from which escape is so difficult, that practically it becomes almost impossible when once the fish or other object of capture has entered them, that the heading we have chosen for them has the advantage of being both suitable and comprehensive. Conspicuous among them are those arrangements of salmon-nets which are included among what are known as "fixed engines." The principle of their construction has a very wide application, and, in some form or other, may be recognised in almost all parts of the world. The plan on which they are arranged is such as to direct the fish into a partially enclosed space, having a wide entrance at one end and a narrow exit at the other; this exit from one enclosure forms the entrance to another, which has a still narrower opening into a third, from which there is no means of escape except by returning through the narrow entrance. In some modified forms there is only a single enclosure, and as an illustration of this we may take the stake-net. It consists of a long line of netting fastened to stakes driven into the shore between tide-marks; this is called the "leader," and terminates at the lower end at the entrance to a broad enclosure, into which the "leader" turns the fish. The two sides of the entrance do not terminate abruptly, but are curved inwards and form a kind of labyrinth from which the fish can hardly escape. The "kettle-net," used for catching mackerel on some parts of our south coast, is of this description, excepting that the enclosure or "pound" is quite simple, and the escape of the fish is cut off by the falling tide. A more elaborate net for salmon-fishing, and known as a "fly-net," is of an oblong shape, broader at the entrance than at the outer end, and having wings of netting fastened inside the mouth, one on each side, and making a kind of flat funnel-shaped entrance. The fish pass through this opening into the body of the net, which is covered above and below, and after a distance of some few feet, a second pair of wings is arranged in the same manner as the first, but with a narrower opening, through which the fish pass to the next enclosure, where a still narrower space between a third pair of wings leads to the final enclosure where the salmon are practically entrapped. This fly-net is kept in position by means of stakes at the sides and ends, and the leader is placed as with the stake-net; in fact, some stake-nets are just the same as the fly-net except in not being covered with netting above and below. Both are placed between tide-marks. Another salmon-net which is much used and known as a "bag-net," is exactly like a fly-net in its construction, but is a floating one instead of being on the ground. It is moored to stakes like the other, but with more freedom of motion within certain limits. The bag-net itself is set below low-water mark, the leader extending from it to high-water mark. The "snap-net" is another contrivance for catching salmon, but not so strictly a trap as those just noticed. It is worked with two boats, each containing a couple of men, who hold the ends of a straight piece of net of moderate length and depth, which hangs in the water between the boats as they drift down the river, one man in each boat holding the head of the net, and the other the foot. When a salmon strikes the net in running up-stream it is immediately felt by the net-holders, the foot of the net is raised and the fish is secured. A different class of fishing apparatus includes the various contrivances which come under the name of weirs. Their construction depends to some extent on the locality in which they are placed. On some parts of the coast, where a considerable extent of sand is laid bare at low-water, the weir consists of a wattled fence so placed as to form a number of zigzags along the line of beach, the lower angles of the weir being just at low-water mark. In one we had an opportunity of inspecting, each arm of a zigzag was about two-hundred yards long, and at the low-water angle a conical wicker-basket with a mouse-trap entrance was firmly fixed at the place where the two arms or fences almost met. The manner in which such a weir works is very simple. At high-water the whole weir is covered by the water, and fish may in some cases enter it above the fence, but as there is nothing to prevent fish from passing round the two ends of the long zigzag weir, no doubt many of those which are caught enter in that direction, and swimming along between the weir and the shore, find their way into the V shaped enclosures, from which, as the tide ebbs and the top of the fence appears above water, they cannot make their escape. Ultimately many of the fish make their way into the wicker-baskets we have mentioned. The fishing-weir used in a salmon-river is of a different kind, although the principle is much the same. Two substantial arms of stone are built in a sloping direction down-stream, one from each bank, but one of the arms is usually much longer than the other, so as to direct the fish towards one side of the river. Between the ends of these arms a series of "cruives" or "cribs" is constructed by means of which all the fish which come down the river may have a good chance of being caught unless they pass through an opening in the centre which is always clear and is called the Queen's Gap. A line of cruives has some resemblance to a battlemented wall, being composed of a long solid mass of masonry a few feet in breadth, having gaps at regular distances along the line. These openings form effective traps. The lower end of each gap has an upright grating to allow the water to pass through, but to stop any fish that may enter, and the upper end or entrance has two swing transverse gratings or "gills" which can be placed at any angle with each other, so as to regulate the width of the entrance, and which interlock when closed. The shutting of these gratings of course closes the cruive, and the fish which may be inside are then taken out with a landing net. The ingenuity of man has devised a great variety of contrivances for catching salmon, and the names by which many of them are known vary according to the locality in which they are used, but they all come within State regulation as to seasons or in some cases even the numbers that may be worked. Lastly, we may shortly notice those traps which are made of basketwork. It is only on the Severn that the contrivances called "putts" and "putchers" are used, and they are long conical baskets with a mouse-trap entrance a short distance inside. Putchers are only small putts. The latter are fastened down in rows with their mouths facing the stream; and putchers are commonly fixed in a wattled fence, technically called a "hedge," each alternate putcher having its mouth in an opposite direction. Eel bucks and lampern wheels are constructed on the same principle, and work in precisely the same manner.

CRAB AND LOBSTER POTS.

There is one great principle adopted in almost all, methods that are in use for catching crabs and lobsters and that is the one familiar to everybody in the common mouse-trap. The entrance to the trap, for such it must properly be called, is funnel-shaped, that is, the external opening is a comparatively wide one, and the passage into the trap terminates in a much narrower opening projecting into the interior. It is what is commonly understood as a mouse-trap entrance. The shape of the trap varies on different parts of our coasts, but the peculiar form of entrance is adopted not only by our own fishermen generally, but by those who are engaged in the same kind of fishing in other parts of the world, and in very many cases it is applied to nets for true fish of different sorts as well as to the ordinary kinds of crustacea. In the west of England the form of trap in universal use is the flattened hemispherical contrivance made of basket-work, commonly known as a "pot." The mouse-trap entrance to this is at the top, and the bottom is weighted with stones inside to ensure the pot falling in the right position when it is thrown overboard. The crabs and lobsters are attracted by the smell of the bait—usually some kind of fish—and crawl down the funnel-shaped entrance at the top, but having once made their way through the funnel and got into the pot, they seem unable to find the inwardly projecting end of the entrance tube, and so cannot escape. Several of these crab-pots are worked together, all being fastened to the same rope, but at some little distance apart; and when they are all sunk to the bottom, the end of the rope, with plenty of slack in it to allow for the rise of tide, is kept afloat by means of corks, and thus the pots can be readily discovered and hauled up several hours after they have been set and left by the fishermen. There is, we believe, a heavy penalty incurred by any unauthorised person who hauls up crab or lobster pots. This is a necessary protection, as the pots must be left to take care of themselves for many hours at a time. The apparatus used on a very large part of our coast for catching crabs and lobsters is of quite a different form and construction from that just mentioned, and consists of an oblong cage rounded over the top and made up of a slight wooden frame covered with netting, the bottom being of wood and of a substantial character, although composed of battens or narrow pieces of wood nailed across the lower frame. The usual mouse-trap entrances are made either in the sides or ends of the cage, the funnel being kept in shape by cane or cord supports. These cages are in most places known as "creels," and they are baited, weighted, and set in just the same manner as has been described in the case of the west country pot. Amateur sea-fishing is now almost unlimited in its scope, and although drift-fishing is still entirely in the hands of professional fishermen, there is hardly any other kind to which yachting men do not give some attention, and crab and lobster fishing has not escaped their notice. One excellent result from this is a vast improvement in creels, although from the greater first cost of the apparatus there is an impediment to their general use by fishermen. The improvement consists simply in having the creels made entirely of zinc or galvanized iron, and wire netting is used instead of that usually made of hemp. These creels always keep in good order, and, notwithstanding the usual prejudice against any alteration from established methods, prove very successful in working. Lastly, we may mention what is called a "trunk," which is simply a ring of iron about two feet across with a shallow bag-net fastened to it below. This is much the same as the hoop-net for large prawns, but with a very much shallower net. It is said that much finer lobsters are caught by the trunk than by the creel, there being of course some limit to the size of the lobsters and crabs which can enter the latter kind of trap, whereas the trunk being entirely open anything that chances to come within the breadth of the iron ring may be caught. But there is an objection to the use of the trunk, inasmuch as it requires some little skill, there being nothing to prevent the escape of the lobster if it should take alarm when the trunk is being hauled up, and the greatest care is necessary just when the trunk is being lifted out of the water, as then the lobster is especially liable to spring backwards and escape. We were once told by an old trunk-fisher that a tailor might work a creel, but it wanted a fisherman to manage a trunk. It is only in parts of the East coast of England that we have seen or heard of trunks being used.

OYSTER DREDGES.

The special instrument used for collecting oysters is the well-known dredge, which has everywhere much the same shape, but differs somewhat in size, as may be seen in the examples exhibited, according to whether it is to be worked from an ordinary rowing boat, or by the small vessels which dredge in comparatively deep water. It consists of an oblong iron frame a few inches wide and having one side, which comes on the ground, flattened and turned forwards at such an angle as to enable it to scrape the surface of the bottom without absolutely tearing it up. The body of the dredge consists of a flat bag, the under part of which is made of iron rings two and a half or three inches in diameter and looped together with strong wire. There is some variation in the construction of this iron network, as may be observed in the Exhibition; but the principle is the same in all—that of providing a strong under surface to the bag, capable of passing over rough ground without liability to injury, and with openings in it large enough to permit the escape of any but fair-sized oysters. The upper surface of the bag is made of stout hemp netting and the iron frame, before spoken of, has the mouth of the bag laced to it and forms its mouth. The handle of the dredge is made up of two stout iron rods firmly welded to the narrow ends of the frame, and joined together at a distance of three feet or more, according to the size of the dredge, and at this point of junction the rope by which the dredge is towed is made fast. The free end of the bag is usually fastened to a stout piece of wood which, placed across it, gives a convenient hold when the contents of the dredge are to be shaken out. Very little skill is required for working the dredge, but some care must be taken to ensure its falling on the ground with the scraper underneath, or it will not work. This difficulty has been got over in the improved dredges, first used by naturalists, by putting a scraper on both sides of the mouth, but such a plan is not so well adapted to the large oyster dredges in use in deep water, as the double scraper, fitted for working properly on whichever side it falls, requires the whole bag to be made of iron ring-net, and adds much to the labour of handling it. From one to six dredges are used at once according to the size and power of the boat. The quantity of tow-rope allowed to the dredge is such as may be necessary, according to the depth of water, to keep the scraper at the proper angle for working over the ground.

HARPOONS.

Although whales do not properly come under the head of "fish," being warm-blooded, air-breathing mammals, they are so commonly spoken of under that name, and their pursuit is so entirely a sea-going business, that a short notice of the instruments used in their capture may be expected. The narratives of Scoresby and others have made us all more or less familiar with the dangers and difficulties attendant on whaling, one of the most serious arising from the necessity for the very close approach of the harpooner to the whale, so as to allow of the harpoon being thrown by him with sufficient force to obtain a good hold in the animal. Having secured this object, the next is to kill the whale as quickly as possible. The hand harpoon of the original form with a simple arrow-head was for a great number of years the only one in use by the different nations which devoted themselves to any extent to whaling, but such an instrument may now be considered obsolete, its place having been taken either by hand harpoons with barbs which are closed in when the harpoon is thrown, and projected as soon as there is a backward strain upon them, or by harpoons or darts fired from a gun, and containing very commonly some kind of explosive substance. Harpoon-guns are of a comparatively ancient date, and their merit consisted only in the force with which they propelled the dart, there being always a difficulty, not yet entirely overcome, in properly directing the course of the harpoon owing to the weight of the rope attached to it. A long series of improvements made in both the United States and England has resulted in bringing the gun and the harpoon to great perfection; and the large interest that America for many years past has had in whaling has naturally led to the production in that country of many of the most valuable improvements which have been made. The guns employed are of two kinds—those fired from the shoulder, and swivel guns. The former are mostly used, and the breech-loading principle for the explosive is now applied to them. The harpoon or dart is of course inserted at the muzzle of the gun. Having "fastened" to a whale with the harpoon, the next thing is to kill the animal as speedily as possible, and this is accomplished by means of what is called a bomb-lance, which is fired from a shoulder-gun, the discharge of which ignites a time-fuse communicating with the powder within the lance and bursting it inside the animal. Such then are the modern means employed in the capture of the largest inhabitants of the ocean; and it will be evident that with such "apparatus for fishing" as we have now briefly noticed, the chance of the whale's escape when once he has been found has been most materially lessened.

In the foregoing sketch of the principal methods of fishing in use, we have been enabled to describe somewhat fully those which are most important and productive in consequence of their being largely carried on in our own waters, as well as elsewhere. The descriptions have been based therefore chiefly on our own ways of fishing. Every country, however, which includes either sea or freshwater fisheries amongst its industries has to some extent national, and, more frequently, local, peculiarities in its mode of working them. But although differences of detail may be found in the construction, dimensions, and fitting up of the nets, lines, and other fishing appliances, not only of foreign countries, but also of our own, the same general principles of working will be recognised in the fishing gear employed throughout the world. One particular method may have special importance in one country, and a different kind may predominate in another; but each is carried on practically in the same manner in whatever seas it may be worked. Methods of fishing new to fishermen generally can hardly be looked for; but there is probably no kind of fishing gear which is not capable of some improvement either in material, fitting, or some other point. It is only in recent